CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable

BACKGROUND OF THE INVENTION

This invention relates to gas turbine engines, specifically to external rotor/internal stator, single stage expansion reaction turbine gas turbine engines.

Brayton thermodynamic cycle internal combustion engines can be categorized by the type of machinery used to compress air and expand combustion gases. The common turbo machinery engine typically has a highly machined finely bladed internal rotor dynamic compressor powered by a similarly bladed internal rotor turbine to expand combustion gases. Unlike the centrifugal or axial compressors, however, the blades of the turbine are completely immersed in hot combustion gases. Extraordinary efforts at developing advanced alloys and sophisticated cooling techniques are necessary to keep the turbine blades operating at reasonably high inlet temperatures and efficiencies. Up to twenty five percent of compressor air is wasted in film cooling of some high performance gas turbine engines. Not only is the engine expensive to design and build, the overall efficiency is reduced by up to ten percent. Moreover, rotor tip clearance leakage losses are significant in an engine that must operate over a range of temperatures including cold start up.
Eliminating the turbine blading in the gas turbine engine was the goal of many inventors for decades.

McNaught (Pat. No. 2,592,938; April, 1952) develops rotational shaft work to power a compressor by expanding combustion gases through nozzles mounted on the periphery of a pressure vessel for a jet reaction turbine. The conventional internal rotor compressor, however, requires a heavy external spinning linkage shell in order to be powered by the turbine. The engine is impractical to fabricate or operate.

More recently Lawler (U.S. Pat. No. 6,347,507; Feb., 2002) mounted ram jets on the tip of a rotor and eliminated, not only the internal rotor of the turbine but the internal rotor of the compressor as well. The philosophy behind what was intended to be the ultimate low tech engine is then promptly contradicted by a high tech rotor which must withstand the enormous rotational stresses due to Mach 2.5 tip speeds.

In addition to air friction losses, fuel delivery or exhaust gas problems, the engine has what might be considered contradictory design points. Since both propulsive efficiency and pressure ratio are always a function of the same parameter, tip speed, the engine designer has limited options to maximize overall efficiency.

SUMMARY OF THE INVENTION

The above problems are elegantly eliminated by the external rotor gas turbine, Fig. 4, in pending patent application Ser. No. 10/090,260. As with the McNaught and Lawler engines the internal rotor bladed turbine is eliminated thereby reducing the surface area contacting the expanding combustion gases which reduces the film cooling requirements and increases the Reynolds numbers. Unlike the McNaught engine, however, the need for complicated rotating machinery and seals is eliminated because the external rotor turbine on this engine is attached to, or integral with, an external rotor dynamic compressor. Moreover, unlike the Lawlor engine, the dynamic compressor allows the engine designer to select and operate at any compression ratio over a broad range of tip speeds for an optimum design point.

The high speed aircraft engine embodiment allows for top end speeds of a ram jet yet with ground take off capability.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1: A cross section along the axis of the center of rotation of a prime mover for generating rotational shaft work **18**. Air enters the external rotor axial compressor from the right side of the engine **20**, and, after combustion in the axially mounted combustion chamber **14**, the gases then move radially out to the tip mounted nozzles **2**. The kinetic energy remaining in the exhaust gas jets is recovered by a ~~one~~ single stage counter rotating impulse turbine **8** located in a radial direction from the nozzles and geared **10** to the reaction turbine. The fuel line is placed inside the hollow shaft **16**.

Fig. 2: A cross section of an aircraft engine embodiment.

Fig. 3: A cross section with the combustion taking place near the rim of the jet rotor.

Fig. 4: A cross section of the preferred embodiment, a prime mover with a two stage external rotor centrifugal compressor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Fig. 4, the external rotor centrifugal compressor on the right side of the drawing supplies the reaction turbine combustor **112** with a sealless rotating source of compressed air. The reaction turbine nozzles **102** are very similar to ram nozzles and allow for relatively high combustion temperatures with little or no film cooling. The fuel line, controls, pump, starter, combustor, regenerator and other peripherals could simply be routed through the center of the compressor on the stator **116** instead of around the outside casing as in a conventional engine.

Preferably, the nozzles in the preferred embodiment are angled ten to 15 degrees in the axial direction so the remaining kinetic energy would power a conventional axial impulse turbine **108** for rotational shaft work **118**.

The design analysis requires only a conventional understanding of the basic principles of fluid mechanics, heat transfer, rotational stresses, and other turbo machinery fields. Except for the throats of the nozzles which may require some film cooling, the heat transfer on the outside of the spinning engine is in the same range as the inside allowing for a substantial increase in inlet temperatures.

The external rotor gas turbine requires no scientific, technological, fabrication or other breakthroughs to design or to build. The radial flow turbine could be fabricated from parts machined on a lathe. An insert would be shaped to fit between the two outer disks, and then cut to produce the desired nozzles. Held in place with a jig, the assembly would be electron beam welded together

In Fig. 4 the cascaded diffuser **104** of the stator of the centrifugal compressor could be fabricated in pie shaped parts and assembled on the stator inside of the carbon fiber element **106** before that element was attached to the rest of the compressor

shell. If a design required film cooling, channels could route air from just downstream from the compressor to the nozzles, similar to film cooling in a ram jet.

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Bret Cahill

Bret Cahill

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